Multi-edged Graphene Nanoribbons

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Its excellent charge-carrier mobility has rendered graphene one of the most promising materials for future use in nanoelectronic development.[1] Since graphene is a zero-gap semimetal, it doesn't feature an energy bandgap, which prevents its usage as logic switching device.[1] By decreasing the width of graphene to a few nanometers a bandgap can be opened that enables semi-conducting properties which are crucial for graphene-based electronic devices such as field-effect transistors (FETs) or solar cells.[1,2] Studies of these so-called graphene nanoribbons (GNRs) have revealed that their bandgaps and charge-carrier mobilities critically depend on their width and edge structures.[2] Several attempts have been made to fabricate atomically precise GNRs by bottom-up synthesis on an Au(111) surface and in solution. Recent highlights utilizing the surface-mediated approach were the successful fabrication of 9-armchair- and 6-zigzag-edge GNRs.[3,4] Both ribbon types exhibit fundamental differences in their electronic properties.[1] As the armchair GNRs are considered as stable and fully benzenoid systems the zigzag edges represent acene-like properties showing localized edge-state at their edge-sites.[1] Since it remains challenging to cleave off the produced ribbons from the surface and only smallest amounts can be fabricated the solution-based approach offers the advantage of up-scaling and a direct process ability if solubilizing substituents as alkyl chains (R) are introduced.[5,6] Our investigations focus on the synthesis of mixed edge structures by Suzuki polymerization to enable new ribbon-types that include cove- and armchair-edges (1 a) or the concept of anti-aromaticity (1 b) by incorporating fluorenofluorene moieties that have been well-studied in our group.[7]

References

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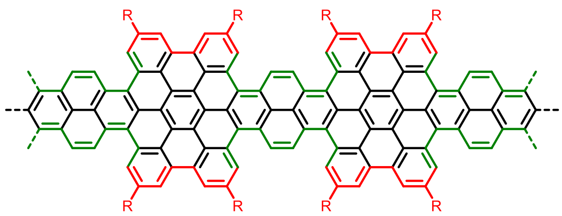
Figure

a



b

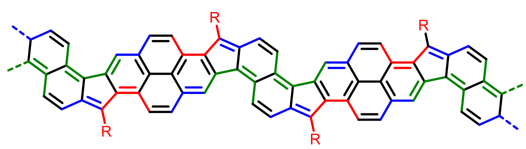


Figure 1: Development of aromatic (a) and anti-aromatic (b) multi-edged GNRs featuring armchair- (red), zigzag- (blue) and cove-edges (green).